



Household Characteristics Associated with the Presence of Stuttering

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Purpose: Previous studies that have examined concordance of stuttering among monozygotic and dizygotic twins indicate both genetic and environmental influences. However, specific environmental influences that may be associated with the presence of stuttering are unresolved. The purpose of this study was to investigate one possible environmental influence – the relationship between household characteristics and stuttering occurrence, using population data.

Methods: Data were used from the Future of Families and Child Wellbeing Study (FFCWS). The FFCWS interviewed parents of children at birth and again in intervals throughout childhood. This study utilized parent reported data, taken when their children were roughly 9 years old. To compare environmental confusion among households, results of the Confusion, Hubbub, and Order Scale (CHAOS) were compared between children who stutter (CWS) and children who do not stutter (CWNS).

Results: The current sample included 106 CWS and 3,239 CWNS, where parental report was suggestive of more CWS living in chaotic environments. Specifically, CWS scored an average of 4.056 (CI=3.978, 4.090) points higher on the CHAOS scale than CWNS.

Conclusions: Current findings suggest that some CWS live in home environments that experience increased congestion, noise, confusion, and lessened stability. These results may indirectly provide justification for indirect approaches to treatment for CWS. This paper offers rationale for such approaches and offers potential clinical benefits that may come from combining direct and indirect approaches to treatment for CWS.

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INTRODUCTION

Stuttering is a communication disorder affecting an estimated five to 10% of the US population [1] with a range of observable and unobservable symptoms [2]. For the past several decades, researchers have sought to identify causal relationships between stuttering and a variety of biological and environmental factors [3-6]. These studies have included examination of stuttering among monozygotic (MZ) and dizygotic (DZ) twins with the consideration of a variety of environmental exposures [7-10]. For example, a 2012 study of MZ and DZ twins who stutter suggested that genetic factors accounted for approximately 80% of variance and nonshared environmental factors accounted for 18% of the variance in stuttering incidence [7]. In a similar MZ and DZ twin study, Felsenfeld [8] reported that genetics accounted for 70% of variance in stuttering, but nonshared environ-

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mental factors played a substantially smaller, yet still significant role in variability. Similarly, a 2007 study reported that MZ concordance rates of stuttering were consistently higher than DZ concordance rates among children as young as three years of age [9]. Other MZ and DZ twin studies have sought to identify specific genetic biomarkers that influenced incidence of stuttering [10], but, to date, no such biomarkers have been identified. Thus, experts generally agree that intrinsic individual-level characteristics of children are primarily responsible for the presence of stuttering. The exogenous, environmental influences, however, and their role in the presence or presentation of stuttering are less resolved.

Several conceptualizations of stuttering have been made to better understand the interplay between genetics, endogenous factors (child-level), and exogenous (environmental) factors that influence the presence of stuttering [3,5,11,12]. One such conceptualization, the Multifactorial Dynamic Pathways (MDP) theory of stuttering [13], explains stuttering in the frame of heterogeneous and nonlinear roles of motor, language, and psychosocial factors to determine the course of stuttering incidence and prevalence. It posits that the intersectional influence of myriads of endogenous and exogenous factors combine to create a setting where stuttering emerges and persists in children and adults. For example, the interaction of genetics, temperament, and household and family dynamics may operate to influence the presence or presentation of stuttering [13].

Regarding household and family dynamics (i.e., components of the child's environment), previous researchers have questioned whether parental interactions may influence either the presence or persistence of stuttering, and an early attempt at this came in the 20th century when Johnson [14] theorized that parents' reactions to a young child's typical disfluencies could induce aberrant behaviors that are characteristic of stuttering. That is, Johnson's theory suggested that the child's environment (namely, interactions with parents) was causal to stuttering by parents bringing negative attention to typical disfluencies, prompting hesitations in the child's speech (i.e., behaviors that would resemble stuttering). Research since has not supported Johnson's theory, which posited stuttering as a condition that is representative of the speaker doing something to their speech. In addition to the previously mentioned twin studies, and in contrast to Johnson's theory, brain imaging findings of structural and physiological differences [15,16] suggest that stuttering is a condition that is acting on the individual. However, questions remain

regarding which environmental factors are influential and exactly how those factors may contribute to the presence of stuttering. That is, parental influences may still be relevant – just not in the way that Johnson hypothesized. Beyond Johnson's theory of incorrect labeling of typical disfluencies, additional relationships between stuttering and parent/child communicative interactions have been considered, though one might argue that they have been considered through the lens of persistence rather than causality. In short, these studies have not yielded strong support for treatment approaches that seek to modify parental behaviors [17-19]. Kloth et al. [20] found in a relatively small sample that fewer complex utterances were used by mothers of children who recovered from stuttering and more complex and more directive language was used by mothers of children who persisted in stuttering; though the clinical significance of utterances consisting of less than a word difference in utterances, found in the Kloth et al. [20] study, has been questioned [18]. Garbarino and Ratner [21] examined the commonly given piece of advice, which is to reduce question asking of CWS. They found that CWS exhibited fewer disfluencies when responding to questions than when speaking other forms of utterances. One issue with studies seeking to identify a definitive relationship between stuttering and an aspect of parent/child interactions is the potential of confounding variables. For example, instructions given from parents to children to adapt their speech, with the intent to change one parameter of speech, may inadvertently adapt another [22]. Specifically, parental rate reductions may result in unintended changes in conversational parameters that may facilitate improvements in the speech of a child who stutters [22]; such as, increasing time duration between conversational exchanges [23]. In the end, for an environmental influence (or alteration of such through intervention) to result in lasting changes, a rewiring of neural networks would likely be necessitated. There are numerous familial or environmental interactions that may act as catalysts to change in the young child [24]. If stuttering is a condition that is acting on the individual, then one consideration is whether or not parent/child communicative interactions (positive or negative) bring about different neural activity when speaking or, temporally, just prior to speaking. Another consideration is whether parent/child communicative interactions, again either positive or negative, can influence temporal or spatial parameters of speech production that may exacerbate or reduce observable symptoms of stuttering. Both of these considerations bring about considerations regarding onset and persistence of stut-

tering. Importantly, all children do not encounter their environments at the same baseline. Children's innate tendencies and differences contribute to how the child will respond to both positive and negative influences in their environment. An example of an intrinsic characteristic that contributes to baseline differences is temperament.

Kraft et al. [4,25] suggested that children's temperament may act as a primary contributor to stuttering severity. These researchers found that stuttering severity was not influenced by the home environment (as measured by the Confusion, Hubbub, and Order Scale [CHAOS]) or significant life events (as measured by the Life Events Checklist [LEC]). However, stuttering severity was influenced by the temperament variable of effortful control, or a child's ability to monitor, regulate, and self-inhibit or activate emotional and behavioral responses, in stuttering variability among CWS. This is not to say that the environment is definitively unrelated to stuttering. As Kraft et al. [25] noted, for CWS with low effortful control, variables within their environments that fall below the threshold for what would be considered chaotic or disorganized could potentially interact with this domain of temperament to influence stuttering. In other words, CWS with low effortful control may be less protected from their environment due to lower triggering thresholds. Studies have reported a relationship between effortful control and stuttering severity, noting that greater abilities in this temperament domain (high effortful control) translate to greater abilities to self-monitor and self-regulate. For a child who stutters, for example, this may allow more productive responses to negative stimuli in order to support use of fluency strategies [4,25]. Young CWS's emotional reactivity and regulatory attempts have been found to be positively associated with the fluency of their utterances; for example, CWS were more likely than children who do not stutter (CWNS) to attempt to regulate emotion preceding fluent utterances. CWS were also more likely to exhibit negative emotions preceding stuttered utterance than they were to exhibit negative emotions preceding fluent utterances [26]. Choi et al. [11] argued that any "high-arousal" effect, including positive emotional reactivity, is associated with increased disfluency, regardless of external emotional stress conditions. Rocha et al. [5] also support the role of temperament and executive functioning as influential variables in stuttering occurrence, as these intrinsic factors impact how children react to their environment. Collectively, evidence points to a number of intrinsic and extrinsic variables that are influential to the presence and presentation of stuttering.

Though evidence supports environment influences as a contributor to stuttering, our understanding of these variables is lacking. While therapeutic approaches have been advanced that seek to adapt the environments of CWS [27-29], it could be argued that these approaches could benefit from supporting evidence. Therefore, the purpose of this study was to investigate the relationship between exogenous variables and stuttering occurrence. Specifically, this project sought to examine household characteristics, using population data, in children who do and do not stutter.

METHODS

Study design

Data were used from the Future of Families and Child Wellbeing Study (FFCWS)—a stratified, multistage sample of 4,700 families made up of 3,600 unwed couples and 1,100 married couples with children born in large U.S. cities between 1998 and 2000. The data are representative of non-marital births in US cities with populations over 200,000 [30]. The FFCWS was designed to address four questions of great interest to researchers and policy makers: 1) profiles of unmarried parents, 2) the state of the unmarried parents' relationships with one another, 3) outcomes of children born into these families, and 4) how families and children are impacted by policies and environmental conditions [31]. Initial data collection was conducted with mothers, fathers, or caregivers shortly after birth and then when children were approximately 1, 3, 5, 9, and 15 years of age via telephone and in-home interviews.

This study utilized Wave 5 (Year 9) which took place between 2007 and 2010 when children were roughly 9 years old [31]. The sample was selected using a complex sample design, where the sample members were not selected independently and were not selected with equal probabilities. For instance, non-marital births were oversampled. Therefore, Mathematica Policy Research has created a set of weights to adjust for the sample design (probability of selection), non-response at baseline, and attrition based on observed characteristics over the waves. The use of survey-provided basic and replicate weights adjusts for the sample design (probability of selection), nonresponse at baseline, and attrition based on observed characteristics over the waves. The replicate weights allow for correct estimation of variance like those obtained by applying Taylor Series methodology. Utilization of both weighting schema in statistical estimation yield correct point estimates as well as deviation matrixes. Since written consent

was obtained from all parents and data were fully de-identified, this study was declared exempt from full board review by a southeastern university's Institutional Review Board (IRB).

Stuttering

In Wave 5, the mother, father, or primary caregiver was asked “In the past 12 months, has {CHILD} had any of the following health problems? ... stuttering or stammering”. Of the 3,345 respondents in Wave 5, 106 (2.21% unweighted) reported the presence of stuttering. While the survey used the terms “stuttering” and “stammering” in the questionnaire, the survey was not asking about two different conditions, as stuttering and stammering are terms that are used interchangeably [32]. According to the documentation on the survey's website, the question about stuttering was asked ninth in a series of 10 related questions regarding conditions experienced in the past 12 months. The format of the questions preceding the question on stuttering or stammering would have likely aided in this understanding as several of the previous questions were asked using synonymous terms, such as “hay fever or respiratory allergy?”, “food or digestive allergy?”, “eczema or skin allergy?”, “frequent diarrhea or colitis?”, and “frequent headaches or migraines?” [31]. Therefore, it is unlikely that the use of stuttering and stammering would have confused the respondents.

Focal child demographic characteristics

Characteristics of the focal child relevant for this analysis included age (in years), sex, (male,* female) race/ethnicity, and household size (number of people). Race/ethnicity was self-identified as one of five categories: non-Hispanic White (“White”),* non-Hispanic Black (“Black”), Hispanic, non-Hispanic Other Race (“Other”), and non-Hispanic Multiracial (“Multiracial”). Due to limited numbers of other and multiracial respondents, these categories were combined for the purpose of this analysis. Asterisks (*) denote those categories subsumed in the reference group. To examine the environmental and contextual differences between children who do and do not stutter, we used a validated measurement instrument that was incorporated into the FFCWS study in Wave 5—the CHAOS.

CHAOS

The original version of the CHAOS Scale contained 15 items measuring parent-reported environmental confusion in the home, defined as “high levels of noise, crowding, and home

traffic pattern.” A short version of the original scale was developed by Petrill et al. [33] to measure environmental confusion in the child's household, indicating excessive noise and a congested housing environment [34]. Wave V of the FFCWS study used five of the six items included in the short version of the CHAOS scale including: “You can't hear yourself think in your home”; “It's a real zoo in your home”; “The children have a regular bedtime routine”; “You are usually able to stay on top of things”; and “The atmosphere in your house is calm”. Answer choices followed a 5-point Likert Scale format, where higher scores are indicative of greater household chaos. A total chaos score can be generated by summing the items following reverse scoring so that high values = high chaos (i.e., reverse score “bedtime routine”, “on top of things”, and “calm atmosphere” items) [34]. The excluded item of the shortened CHAOS scale was “There is usually a television turned on somewhere in our home”.

Statistical analysis

To compute unbiased and efficient statistical estimates that account for the complex FFCWS sample design, all statistical evaluation used both “basic” and “replicate” weights provided in the FFCWS data release. The basic weights resulted in a sample that was representative of births occurring in large U.S. cities (the 77 U.S. cities with populations over 200,000 in 1994) between 1998 and 2000. The use of replicate weights allowed variance parameters to be correctly estimated by correcting non-response, reporting, and selection biases. Replicate weights were applied with a unit multiplier using a jackknife procedure for standard errors. Using this weighting schema, we first compared the sample characteristics and mean CHAOS score for CWS and CWNS using chi-squared and t-statistics, respectively. Then we conducted multivariable regression analysis using age, sex, race/ethnicity, household size, household income, maternal education, and maternal marital status as independent regressors. All analyses were performed using SAS 9.4 (Cary, NC) survey procedures which accounted for the complex sampling structure of the data and incorporated appropriate wave-specific sampling weights.

RESULTS

Demographics

The current sample included 106 CWS, consisting primarily of males (76.42%), compared to 3,239 CWNS, comprised of significantly fewer males (51.0%). The total sample of children

ranged in age from 8.6 to 10.9 years with an average age of 9.28 years ($SD=0.37$). Chi-square tests indicated that the racial and ethnic representation differed significantly between CWS and CWNS, ($\chi^2=13.79$, $p=0.008$), with the sample of CWNS being 18.3% White and 49.01% Black compared to 4.4% and 62.64% of CWS. Additionally, households of families of CWS earned significantly less (\$33,024.26, $SD=\$25,732.23$) than household of families of CWNS (\$48,972.78, $SD=\$54,447.78$) ($F=4.25$, $p<0.0001$). Most CWS (76.42%) were male compared to only 51.00% of CWNS ($\chi^2=26.55$, $p<0.0001$). Significant differences were present in mother's educational attainment ($\chi^2=7.69$, $p=0.0529$), where over 15% of mothers of CWNS had a college

degree or above and 41.76% had some college or technical education as compared to only 8.65% and 36.54% of mothers of CWS. Additionally, significant differences were present regarding marital status (marital status $\chi^2=6.48$, $p=0.0109$), where 30.36% of mothers of CWNS were married as compared to only 18.63% of mothers of CWS. Table 1 provides detailed demographic information for CWS and CWNS.

CWNS had a mean CHAOS score of 8.60 ($SD=3.68$) compared 9.69 ($SD=3.68$) among CWS—a statistically significant difference ($t=2.31$, $p=0.0212$). Examination of differences in the five individual items in the CHAOS scale between CWS and CWNS indicated statistically significant differences in

Table 1. Demographic characteristics of children who do and do not stutter from wave 5 of the future of families and child wellbeing study

	CWNS N = 3,239 (97.8%)		CWS N = 106 (2.21%)		Test of between group difference	
	Mean	Std deviation	Mean	Std deviation	t-statistic	p-value
Age (yr)						
Age (8.6-10.9)	9.28	-0.37	9.26	-0.34	-0.71	0.4792
Total household size (people)						
Individuals (1-11)	4.63	-1.59	4.92	1.68	1.77	0.077
Confusion, Hubbub, and Order Scale						
CHAOS	8.60	3.68	9.69	3.68	2.31	0.0212
You can't hear yourself think in your home	2.16	1.42	2.46	1.54	2.13	0.0332
It's a real zoo in your home	1.95	1.37	2.18	1.50	2.70	0.0289
The children have a regular bedtime routine	1.39	0.93	1.44	1.01	0.54	0.5915
You are usually able to stay on top of things	1.54	0.86	1.56	0.81	0.15	0.8770
The atmosphere in your house is calm	1.89	1.10	2.08	1.20	1.79	0.0729
	N	Percent	N	Percent	χ^2	p-value
Race/Ethnicity						
Non-Hispanic White	543	18.3	4	4.4	13.79	0.008
Non-Hispanic Black	1,454	49.01	57	62.64		
Hispanic	734	24.74	24	26.37		
Non-Hispanic Other/Multiracial	236	7.95	6	6.59		
Sex						
Male	1,652	51.00	81	76.42	26.55	<.0001
Female	1,587	49.00	25	23.58		
Annual Household Income (\$)						
<\$20,000	655	28.42	26	34.21	8.39	0.0151
\$20,000 - \$60,000	998	43.30	40	52.63		
>\$60,000	652	28.29	10	13.16		
Mother's educational attainment						
≤8th grade	647	20.83	30	28.85	7.69	0.0529
High school or equivalent	677	21.80	27	25.96		
Some college, technical	1,297	41.76	38	36.54		
College or graduate degree	485	15.61	9	8.65		
Mother's marital status						
Married	927	30.36	19	18.63	6.48	0.0109
Unmarried	2,126	69.64	83	81.37		

those reporting that they “can’t hear yourself think in your home” (CWNS 2.16, SD=1.42; CWS 2.46, SD=1.54; $t=2.13$, $p=0.0332$) and “it’s a real zoo in your home” (CWNS 1.95, SD=1.37; CWS 2.18, SD=1.50; $t=2.70$, $p=0.0082$).

Regression analysis

Table 2 presents results for regression analysis of CHAOS Scale scores for CWS and CWNS. Regression models included individual and maternal characteristics. After verifying that the assumptions of multiple linear regression had been met, the analysis showed that, on average, females had 0.670 (CI= -1.214, -0.126) lower CHAOS scores compared to males while CWS scored an average of 4.056 (CI=3.978, 4.090) points higher on the CHAOS scale than CWNS, all else held constant. Similarly, *ceteris parabis*, children in households earning less than \$20,000 annually had CHAOS score that was 1.687 (CI= 0.948, 2.427) higher than children in households earning over \$60,000. Additionally, accounting for demographic and household differences, children in larger household reported higher CHAOS scores. Scores increased an average of 0.645

(CI=0.400, 0.889) with each additional household member even after controlling for demographic and maternal differences.

DISCUSSION

The primary finding of the current study was that CWS in the current sample, as compared to CWNS, were more likely to live in tumultuous households, as measured by the CHAOS scale. Before proceeding, a consideration for interpreting the current results is that the current FFCWS sample (both CWS and CWNS) is comprised of three-quarters of children born to unmarried parents. While each individual and family situation is different, it is not difficult to envision multiple scenarios where single-family households are inherently positioned to face greater challenges. Therefore, the results are likely most reflective of household environments with this type of make-up and potential challenges. Due to the nature of the current data, directionality of influence cannot be assigned. That is, while the current sample suggests an association between

Table 2. Multivariable regression analysis of Confusion, Hubbub, and Order Scale among CWNS and CWS

Dependent Variable: Confusion, Hubbub, and Order Scale (CHAOS)						
F-Statistic	26.18					
Prob >F	0.000					
R-squared	0.0978					
	Coefficient	Jackknife Std Error	t	p > t	95% Confidence interval	
Age	0.004	0.026	0.15	0.884	-0.050	0.058
Household size	0.645	0.119	5.43	0.000	0.400	0.889
Female	-0.670	0.264	-2.54	0.018	-1.214	-0.126
Stuttering	4.056	0.959	3.03	0.020	3.978	4.090
Income <\$20,000	1.687	0.359	4.7	0.000	0.948	2.427
\$20,000 < Income <\$60,000	0.915	0.549	1.67	0.108	-0.216	2.046
Mother married	-0.502	0.326	-1.54	0.136	-1.174	0.169
NH Black	-1.036	0.782	-1.33	0.197	-2.647	0.574
Hispanic	-0.926	0.937	-0.99	0.332	-2.855	1.003
NH Other/Multiracial	-0.033	0.944	-0.03	0.973	-1.978	1.913
Mother's education ≤8th grade	-0.793	0.793	-1	0.327	-2.427	0.842
Mother's education high school or equivalent	-0.207	0.750	-0.28	0.785	-1.752	1.338
Mother's education some college, technical	-0.269	0.435	-0.62	0.541	-1.166	0.627
Intercept	6.746	1.136	5.94	0.000	4.407	9.086

Indicates statistically significant at a 95% confidence level.

Reference group: Sex (male), Stuttering (no stuttering), Income (>\$60,000), Maternal marital status (unmarried), Race/ethnicity (NH White), Maternal education (college or graduate degree).

stuttering and chaotic households, we want to caution readers that we cannot say that households with increased congestion, noise, confusion, and lessened stability contribute causally to the presence or persistence of stuttering. Nevertheless, the findings from the current study raise several theoretical questions that should be addressed in future studies that will further inform clinicians and families on the influence of environmental factors on stuttering.

Yaruss et al.'s [29] Family-Focused Treatment Approach offers a useful analogy to help conceptualize the contribution of extrinsic variables to moments of stuttering. In the bucket analogy, factors contributing to stuttering are represented by water filling the bucket, where too many factors (i.e., too much water) results in the bucket overflowing (i.e., stuttering). Parents are taught that some contributors can be controlled while others cannot. Factors that are out of the control of parents include intrinsic factors such as genetics or the child's temperament. However, there are environmental factors that are within the control of parents, and if it is found that those environmental factors are contributing to the overflowing of the child's "bucket", they should be given attention. Merging current findings with Yaruss' bucket analogy offers important considerations for identifying and potentially lessening extrinsic contributors to moments of stuttering in older children, but perhaps of greater significance are these considerations for younger CWS – who are within windows of time with greater chances of natural recovery. Removing or lessening environmental influences that contribute to the overflowing of the bucket (i.e., stuttering) would in turn bring about non-stuttered speech, theoretically creating occurrences of speaking without stuttering. Specific to current findings, factors that could potentially result in "an overflowing of the bucket" include characterizations derived from items of the CHAOS scale, including characterizing a house as a zoo and not being able to hear yourself think when in your home. It has been speculated that successes in treatment of stuttering in young children may be the result of leveraging neuronal plasticity [35], and Ma et al. [36] provided a scientific explanation of such when describing that,

"when one cell fires another repeatedly, the efficiency of exciting the second cell increases over time. Long-term potentiation (or, broadly, long-term depression) provides strong evidence to support Hebb because the postsynaptic cell's depolarization is coincident with the presynaptic neuron. Thus, Hebb predicted that simultaneous repeated activation of cells will lead to pronounced changes in syn-

aptic strength. High amounts of motor practice have led to repetitive stimulation of the neurons in the motor network" (p. 69).

That is to say that synaptic strength is achieved as a byproduct of speech that occurs within an environment that either promotes stuttered or non-stuttered speech. Referring back to the bucket analogy, parents who remove factors that cause an overflowing of the bucket help the child by creating outputs which are absent of stuttering, and repeated instances of such possibly leads to long-term potentiation (i.e., leveraging neuronal plasticity in the direction of non-stuttered speech). This gives speech-language pathologists and parents an understanding of the types of environments they should be creating and those that they should be avoiding. As offered by current data, environments that are associated with differences between some CWS and CWNS are those that promote excitability. Discussing excitability in children and in CWS, Guitar [2] stated,

"a child's speech neural networks are immature, are not fully myelinated, and may not be buffered from "cross talk", or interference by the limbic (emotional) system structures and pathways involved in the regulation and expression of emotion (e.g., [37]). Such interference may be even more likely among many children predisposed to stutter. Their slower maturing speech production system may not be optimally localized or adequately insulated from interference and may be closer to centers of emotion in the right hemisphere" (p. 76).

Application of this statement by Guitar to the current findings would mean that "cross talk" may arise when a child who is susceptible to stuttering attempts to communicate in a household where it is characterized as a zoo and when a child is not able to hear themselves think when in their home. Additionally, "cross talk" could be lessened by improvements made to the home environment. That is, by increasing stability and lessening congestion, noise, and confusion in the CWS' household, the parent(s) could potentially improve the stuttering outcomes in a young child. Implications for such go beyond the day-to-day frustration that stuttering may instill on the child and the child's family. Specifically, future research might clarify if recovery rates can be improved through therapeutic interventions, at young ages, that work towards inducing speech that is absent of observable stuttering behaviors while also adapting the child's environment to one that is less cognitively and emotionally taxing. Ultimately, an approach that leverages the combined benefits of both indirect

and direct treatments will likely foster the most change.

While direct and indirect treatments for young CWS operate under different frameworks [38], both have shown to be effective in the treatment of stuttering [39]. Though these treatment approaches differ in presentation and instruction given to families, one possibility is that their effectiveness lies in their capabilities of creating perceivably fluent speech outcomes in CWS. Clinically, this would mean that parents and speech-language pathologists should target several approaches to bring about as many utterances as possible that are absent of observable stuttering behaviors or, in the case of direct approaches (e.g., verbal contingencies used in the Lidcombe Program [40]), revisions to stuttered speech. For young CWS, this would include a combination of direct and indirect approaches. In short, stuttered speech can be combatted using both direct and indirect methods, and to withhold either of these methods likely misses on opportunities where stuttered speech could be replaced by speech that is absent of observable behaviors. A case could be made for the same course of action for older CWS that may appear to be out of the window of natural recovery. Due to reports of natural recovery in older individuals, albeit at significantly lower rates [41], continued focus on improving environments might prove to be clinically relevant and certainly would not harm PWS. Additionally, even when stuttering is persistent, adapting aspects of the CWS' environment(s) can facilitate acceptance of stuttering which ultimately promotes approach versus avoidance behaviors and contributes to the reduction of the adverse impact of stuttering [42-44]. The home environment is just one of many settings that may bring about excitability in a PWS and, in future studies, other contexts should be considered as well.

Additional notable findings

Before concluding, an examination of demographic characteristics revealed differences that warrant mentioning. Consistently, males are found to stutter at higher rates than females [1,45] and current findings are in line with those previous reports. Racial differences were present among CWNS and CWS, with the most notable discrepancies being that of Non-Hispanic White CWNS (18.3%) and Non-Hispanic White CWS (4.4%) and Non-Hispanic Black CWNS (49.01%) and Non-Hispanic Black CWS (62.64%). Few studies have explored differences in the presence of stuttering as a function of racial/ethnic group. Using 2010-2015 merged data from the National Health Interview Survey, Briley and Ellis [46] found that African American children were at greater odds of stutter-

ing as compared to white children. However, differences were not present in odds of stuttering when comparing white and Hispanic children. Additional previous examinations of the presence of stuttering as a function of race have been both in support [47] and in contrast [48] to current findings. Future studies are needed to resolve the meaning of these differences. Annual household income also differed between the two groups, favoring CWNS. Current data does not provide justification for this finding, though given the evidence for a genetic bases of stuttering [1], one possibility is that CWS may be residing in homes with a parent who also stutters. Since previous literature has found a relationship between stuttering and decreased earnings [49,50], this association could help to explain the current differences in household income between CWNS and CWS.

CONCLUSIONS

Present findings offer evidence that for some CWS, the home environment can be described as having increased congestion, noise, confusion, and lessened stability. These results indirectly provide justification for indirect approaches to treatment for CWS. The current discussion offers rationale for such and gives rise to future research questions that would advance our understanding of clinical benefits that may come from indirect approaches and the combination of indirect approaches with direct approaches.

Limitations

While these findings are interesting, they do come with limitations. First, there are numerous variables that may contribute to a chaotic household and the current study does not attempt to identify those various contributors. Second, due to make-up of the FFCWS sample (comprised of three-quarters of children born to unmarried parents), the results are likely most reflective of single-parent household environments. For that reason, it would be interesting in future studies to assess similar constructs with samples whose proportions of married/unmarried parents mirror that of national averages. Additionally, current data do not offer directionality of influence, meaning we cannot be certain if these variables influence stuttering or if stuttering influences these variables. Another consideration is if these variables contribute to the condition itself, to the observable moments of stuttering, to the overall impact of the disorder, or to all three. Experimental evidence is needed to answer these questions. That is, does adapting

aspects of the home alter the course of the condition of stuttering, on moments of stuttering, on cognitive, social, and emotional impacts of stuttering, or all of the above? To this point, consideration should also be given to the effects of adapting home environments at various ages and how these outcomes differ as a function of age. Lastly, since the ages of the current sample are beyond the preschool years, future studies should examine home environments of CWS that are at ages closer to typical onset of stuttering.

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Data availability statement

The Future of Families & Child Wellbeing Study (FFCWS) releases restricted use contract data to the public via a Contract Data Agreement. Access to the FFCWS contract data is limited to researchers who agree to the terms and conditions contained in the Contract Data License. Access to the FFCWS contract data requires researchers to comply with data use standards and regulations.

REFERENCES

1. Yairi E, Ambrose N. Epidemiology of stuttering: 21st century advances. *Journal of Fluency Disorders*. 2013;38(2):66-87.
2. Guitar B. *Stuttering: An integrated approach to its nature and treatment*. Wolters Kluwer; 2019.
3. Walden TA, Frankel CB, Buhr AP, Johnson KN, Conture EG, Karrass JM. Dual diathesis-stressor model of emotional and linguistic contributions to developmental stuttering. *Journal of Abnormal Child Psychology*. 2012;40(4):633-644.
4. Kraft SJ, Ambrose N, Chon H. Temperament and environmental contributions to stuttering severity in children: The role of effortful control. *Seminars in Speech and Language*. 2014;35(2):080-094.
5. Rocha MS, Yaruss JS, Rato JR. Temperament, executive functioning, and anxiety in school-age children who stutter. *Frontiers in Psychology*. 2019;4(10):2244.
6. Singer CM, Hessling A, Kelly EM, Singer L, Jones RM. Clinical characteristics associated with stuttering persistence: A meta-analysis. *Journal of Speech, Language, and Hearing Research*. 2020;56(9):2995-3018.
7. Rautakoski P, Hannus T, Simberg S, Sandnabba NK, Santtila P. Genetic and environmental effects on stuttering: a twin study from Finland. *Journal of Fluency Disorders*. 2012;37(3):202-210.
8. Felsenfeld S, Kirk KM, Zhu G, Statham DJ, Neale MC, Martin NG. A study of the genetic and environmental etiology of stuttering in a selected twin sample. *Behavior Genetics*. 2000;30:359-366.
9. Dworzynski K, Remington A, Rijsdijk F, Howell P, Plomin R. Genetic etiology in cases of recovered and persistent stuttering in an unselected, longitudinal sample of young twins. *American Journal of Speech-Language Pathology*. 2007;16(2):169-178.
10. Frigerio-Domingues C, Drayna D. Genetic contributions to stuttering: the current evidence. *Molecular Genetics & Genomic Medicine*. 2017;5(2):95-102.
11. Choi D, Conture EG, Walden TA, Jones RM, Kim H. Emotional diathesis, emotional stress, and childhood stuttering. *Journal of Speech, Language, and Hearing Research*. 2016;59(4):616-630.
12. Starkweather CW, Gottwald SR. The demands and capacities model II: Clinical applications. *Journal of Fluency Disorders*. 1990;15(3):143-157.
13. Smith A, Weber C. How stuttering develops: The multifactorial dynamic pathways theory. *Journal of Speech, Language, and Hearing Research*. 2017;60(9):2483-2505.
14. Johnson W. The role of evaluation in stuttering behavior. *Journal of Speech Disorders*. 1938;3(2):85-89.
15. Chang SE, Garnett EO, Etchell A, Chow HM. Functional and neuroanatomical bases of developmental stuttering: current insights. *The Neuroscientist*. 2019;25(6):566-582.
16. Neef NE, Angstadt M, Koenraads SP, Chang SE. Dissecting structural connectivity of the left and right inferior frontal cortex in children who stutter. *Cerebral Cortex*. 2023;33(7):4085-4100.
17. Nippold MA, Rudzinski M. Parents' speech and children's stuttering: A critique of the literature. *Journal of Speech, Language, and Hearing Research*. 1995;38(5):978-989.
18. Ratner NB. Caregiver-child interactions and their impact on children's fluency: Implications for treatment. *Language, Speech, and Hearing Services in Schools*. 2004;35:46-56.
19. Ryan BP. Speaking rate, conversational speech acts, interruption, and linguistic complexity of 20 pre-school stuttering and non-stuttering children and their mothers. *Clinical Linguistics & Phonetics*. 2000;14(1):25-51.
20. Kloth SA, Kraaimaat FW, Janssen PE, Bruten GJ. Persistence and remission of incipient stuttering among high-risk children. *Journal of Fluency Disorders*. 1999;24(4):253-265.
21. Garbarino J, Bernstein Ratner N. What Is the Role of Questioning in Young Children's Fluency?. *American Journal of Speech-Language Pathology*. 2022;31(5):2061-2077.
22. Ratner NB. Measurable outcomes of instructions to modify normal parent-child verbal interactions: Implications for indirect stuttering therapy. *Journal of Speech, Language, and Hearing Research*. 1992;35(1):14-20.
23. Newman LL, Smit AB. Some effects of variations in response time latency on speech rate, interruptions, and fluency in children's speech. *Journal of Speech, Language, and Hearing Research*. 1989;32(3):635-644.
24. McGowan PO, Szyf M. The epigenetics of social adversity in early life: implications for mental health outcomes. *Neurobiology of Disease*. 2010;39(1):66-72.

25. Kraft SJ, Lowther E, Beilby J. The role of effortful control in stuttering severity in children: Replication study. *American Journal of Speech-Language Pathology*. 2019;28(1):14-28.
26. Jones RM, Conture EG, Walden TA. Emotional reactivity and regulation associated with fluent and stuttered utterances of pre-school-age children who stutter. *Journal of Communication Disorders*. 2014;48:38-51.
27. Cooperman DK, Bloom Sr CM. Point-counterpoint: Synergistic stuttering therapy: holistic treatment for people who stutter. *Perspectives on Fluency and Fluency Disorders*. 2002;12(1):5-8.
28. Kelman E, Nicholas A. Practical intervention for early childhood stammering: Palin PCI approach. Routledge; 2017.
29. Yaruss JS, Coleman C, Hammer D. Treating preschool children who stutter: Description and preliminary evaluation of a family-focused treatment approach. *Language, Speech, and Hearing Services in Schools*. 2006;37(2):118-136.
30. Reichman NE, Teitler JO, Garfinkel I, McLanahan SS. Fragile families: Sample and design. *Children and Youth Services Review*. 2001;23(4-5):303-326.
31. Bendheim-Thoman Center for Research on Child and Family Wellbeing. Future of Families and Child Wellbeing Study. [Internet]. 2018 [cited 2024 Mar 6]. Available from: <https://cwcw.princeton.edu/fragile-families-and-child-wellbeing-study>
32. National Institute on Deafness and Other Communication Disorders. Stuttering. [Internet]. 2017 [cited 2024 Mar 6]. Available from: <https://www.nidcd.nih.gov/health/stuttering#:~:text=Stuttering%20is%20a%20speech%20disorder,a%20normal%20flow%20of%20speech.>
33. Petrill SA, Pike A, Price T, Plomin R. Chaos in the home and socioeconomic status are associated with cognitive development in early childhood: Environmental mediators identified in a genetic design. *Intelligence*. 2004;32(5):445-460.
34. User's Guide for the Fragile Families and Child Wellbeing Study Public Data, Year 9. Scale – Environmental Confusion (CHAOS). [Internet]. 2018. Available from: <https://ffcws.princeton.edu/data-and-documentation/scales-and-concepts-documentation>
35. Lincoln MA, Onslow M. Long-term outcome of early intervention for stuttering. *American Journal of Speech-Language Pathology*. 1997;6(1):51-58.
36. Ma L, Wang B, Narayana S, Hazeltine E, Chen X, Robin DA, Fox PT, Xiong J. Changes in regional activity are accompanied with changes in inter-regional connectivity during 4 weeks motor learning. *Brain Research*. 2010;1318:64-76.
37. Dolcos F, McCarthy G. Brain systems mediating cognitive interference by emotional distraction. *Journal of Neuroscience*. 2006;26(7):2072-2079.
38. Boucand VA, Millard S, Packman A. Early intervention for stuttering: similarities and differences between two programs. *Perspectives on Fluency and Fluency Disorders*. 2014;24(1):8-19.
39. Franken MC, Kielstra-Van der Schalk CJ, Boelens H. Experimental treatment of early stuttering: A preliminary study. *Journal of Fluency Disorders*. 2005;30(3):189-199.
40. Lidcombe Program Trainers Consortium. Lidcombe Program Treatment Guide. [Internet]. 2024 [cited 2024 Mar 6]. Available from: <https://lidcombeprogram.org/helpful-resources/helpful-downloads/>
41. Yairi E, Seery CH. Stuttering: Foundations and clinical applications. Plural publishing; 2021.
42. Adriaenssens S, Struyf E. Secondary school teachers' beliefs, attitudes, and reactions to stuttering. *Language, Speech, and Hearing Services in Schools*. 2016;47(2):135-147.
43. Lau SR, Beilby JM, Byrnes ML, Hennessey NW. Parenting styles and attachment in school-aged children who stutter. *Journal of Communication Disorders*. 2012;45(2):98-110.
44. Yaruss JS, Coleman CE, Quesal RW. Stuttering in school-age children: A comprehensive approach to treatment. *Language, Speech, and Hearing Services in Schools*. 2012;43(4):536-548.
45. Briley PM, Ellis Jr, C. The coexistence of disabling conditions in children who stutter: evidence from the National Health Interview Survey. *Journal of Speech, Language, and Hearing Research*. 2018; 61(12):2895-2905.
46. Briley PM, Ellis C. The influence of ethnicity and residence on presence of stuttering in children. *Journal of the National Black Association for Speech Language and Hearing*. 2020;15(1):21-30.
47. Boyle CA, Boulet S, Schieve LA, Cohen RA, Blumberg SJ, Yeargin-Allsopp M, et al. Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics*. 2011;127(6):1034-1042.
48. Proctor A, Yairi E, Duff MC, Zhang J. Prevalence of stuttering in African American preschoolers. *Journal of Speech, Language and Hearing Research*. 2008;51(6):1465-1479.
49. Briley PM, Jacobs MM. Speech therapy and Earnings: Economic benefits for individuals who stutter. *Seminars in Speech and Language*. 2022;43(3):233-243.
50. Gerlach H, Totty E, Subramanian A, Zebrowski P. Stuttering and labor market outcomes in the United States. *Journal of Speech, Language, and Hearing Research*. 2018;61(7):1649-1663.